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Effect of Crop Phenology and Habitat on the Diet of Common Grackles (Quiscalus quiscula)

ABSTRACT.—Esophageal contents of 842 common grackles (*Quiscalus quiscula*), collected in north-central North Dakota from 1 May–21 October 1989, were examined. The esophageal contents varied significantly between habitats and seasons ($P \leq 0.05$) but did not differ among age-sex classes ($P > 0.05$). Insects comprised 79% (mean dry weight) of the diet during May and June. From July to mid-August, common grackles ate primarily small grains (42%) and insects (34%); whereas, between mid-August and late October small grains (36%) and sunflower seeds (48%) were important diet items. Overall, crop phenology and habitat influenced the diets of common grackles.

INTRODUCTION

Common grackles (*Quiscalus quiscula*) are abundant in the northern Great Plains during the spring and summer (Robbins *et al.*, 1986; Nelms, 1991; Homan, 1992). In North Dakota, their breeding population increased from 334,500 breeding pairs in 1967 to 777,000 pairs in 1990 (Stewart and Kantrud, 1972; Nelms, 1991). Since oil-seed sunflower cultivars became an economically viable crop in the late 1960s (Sunflower Production and Marketing, 1978), large flocks of blackbirds, composed of common grackles, red-winged blackbirds (*Agelaius phoeniceus*) and yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), have fed in ripening sunflower fields in late summer. The esophageal contents of red-winged and yellow-headed blackbirds collected in sunflower-growing regions of North Dakota indicate that both species damage sunflowers (Linz *et al.*, 1983; Linz *et al.*, 1984; Twedt *et al.*, 1991). Although common grackles may be important consumers of sunflower seeds, data documenting their importance as a pest is not available.

We collected common grackles in Benson County, North Dakota, from 1 May–21 October 1989. Our objectives were to (1) determine the esophageal contents of different age and sex classes of common grackles collected within crop and noncrop habitats in relation to crop phenology and (2) compare common grackle diets with those of red-winged blackbirds and yellow-headed blackbirds. Information on the diet of common grackles, combined with data on their nesting ecology (Homan, 1992), may aid biologists in developing strategies for reducing the impact of common grackles on the sunflower crop.

STUDY AREA AND METHODS

Study area.—Benson County (364,900 ha) is located in north-central North Dakota in the Drift Plain physiographic region (Stewart, 1975). The terrain is flat to gently rolling, with cropland interspersed with numerous shelterbelts. Approximately 56% of Benson County was cultivated in 1989 (North Dakota Agric. Statistics Serv., 1990); two-thirds of the cropped land was planted to wheat, barley and oats (small grains). Sunflower and corn were planted on 10% and 2% of the hectares planted in 1989, respectively. Minor crops (*e.g.*, rye, flax, edible beans and soybeans) accounted for <3% of the cropped land. Hay was grown on 12% of the cultivated land. Average annual precipitation is 42 cm, over 75% of which occurs from April to September (North Dakota Agric. Statistics Serv., 1990). Average temperatures range from −16.5 C in January to 21 C in July. The mean frost-free season is from 23 May to 13 September.

Bird collections and processing.—We systematically searched Benson County 1–2 times weekly between 1 May and 21 October, 1989, for flocks of blackbirds and shot common grackles whenever they were encountered. Additionally, common grackles were collected from flight-lines as they entered roosts in the evening. Specimens were placed in plastic bags and packed on ice immediately after collection. The birds were processed within 4 h or frozen for later processing.

Each bird was weighed, sexed by gonadal examination and aged (young-of-the-year or adult) by the presence or absence of the bursa of Fabricius (Wright and Wright, 1944). Foods were removed from the esophagus and oral cavity, placed in ethanol, and classified as sunflower, corn, small grains,

weed seeds [largely foxtail (*Setaria* spp.) and wild oats (*Avena* spp.)], insects, grit and unidentifiable matter. All foods were oven-dried at 70 C for 36 to 48 h, air cooled and weighed to the nearest 0.001 g.

Statistical analyses.—Only common grackles of known age and sex that contained at least one food item were included in the statistical analyses. Food was found in 842 of 3902 common grackles collected in crop (sunflower, corn and small grains; n = 602) and noncrop habitats (wetlands, shelterbelts and flight-lines; n = 240). Only 9 of 108 birds collected in corn and small grain habitats contained food and were omitted from further analyses. Food items weighing <0.001 g were recorded as 0.001 g to indicate that at least one food item was present. Grit was omitted from the analyses.

We used multivariate analysis of variance (MANOVA) on arcsine-transformed (Zar, 1984:239–240) mean proportions of esophageal dry weight to compare among age-sex classes, habitats and seasons (SAS Institute, Inc., 1988). Esophageal contents differed between birds collected from sunflower and noncrop habitats; therefore, comparisons were made between age and sex classes and seasons within habitats.

We divided the collecting periods into four seasons: spring (1 May–30 June), summer (1 July–14 August), late summer (15 August–16 September) and fall (17 September–21 October). These intervals were chosen because (1) before 1 July many of the adults were gathering food for their young, (2) after 1 July the majority of fledglings were independent and common grackles began to form flocks, (3) 15 August corresponded to the onset of the soft-seed stage of sunflower development in Benson County in 1989 and (4) 17 September coincided with the beginning of the dry-down stage of sunflower in 1989. Esophageal contents of birds collected in the spring were analyzed separately from those collected later in the year because (1) nesting birds were foraging for themselves and their offspring which may have influenced food choice and (2) the young-of-the-year age class was not represented in the samples. F-statistics, based on Wilks' lambda, refer to simultaneous comparison of all dietary categories. Statistical significance was accepted at $P \leq 0.05$.

Food consumption values are expressed in mean percent dry weights and relative percent frequencies of occurrence. The mean percent dry weight for each food category was the mean of the dry weight proportions from all individuals multiplied by 100 (Swanson *et al.*, 1974). The relative percent frequency of occurrence was the number of birds containing a food item divided by the total number of occurrences of all food items in all birds multiplied by 100 (Twedt *et al.*, 1991).

RESULTS

Birds from all habitats.—Common grackles collected in sunflower and noncrop habitats contained different proportions of food items ($F = 54.73$, df = 5, 722, $P < 0.001$). Therefore, esophageal contents among age-sex classes were compared within each habitat. Male and female common grackles, pooled over all collection periods had mean weights of 122.5 g (n = 1289, SD = 8.6) and 96.3 g (n = 1228, SD = 7.0), respectively.

Birds from noncrop habitats.—During spring, 58 of 520 common grackles that were collected in and around nesting colonies contained food in their esophagus. Sexes did not differ ($F = 1.68$, df = 2, 55, $P = 0.192$) in esophageal contents. Their diets, in decreasing order, consisted of insects, small grains and waste sunflower (Table 1).

During the summer, late-summer and fall, 182 of 2145 common grackles collected in noncrop habitats contained esophageal food. Interactions between age and sex ($F = 0.405$, df = 6, 165, $P = 0.875$), season and age ($F = 0.844$, df = 12, 330, $P = 0.605$) or season and sex ($F = 0.868$, df = 12, 330, $P = 0.580$) were not significant. Furthermore, esophageal contents did not differ between age classes ($F = 0.30$, df = 6, 165, $P = 0.936$) or between sexes ($F = 1.51$, df = 6, 165, $P = 0.179$).

Esophageal contents differed among the summer, late-summer and fall seasons ($F = 4.70$, df = 12, 330, $P < 0.001$). Small grains were consistently eaten from summer through fall, making up about 38% of the diet. Common grackles contained significantly more sunflower with each ensuing season, peaking at about 55% of their diet during the fall (Table 1). Insect consumption decreased throughout the study period. However, frequency of occurrence of insects stabilized at about 25% during late-summer and fall. The occurrence of insects during this time was due to the high densities of larval sunflower seed weevils (*Smicronyx* spp.) which live in sunflower seeds.

Birds in sunflower fields.—Between 15 August–21 October (*i.e.*, late summer and fall) 602 of 1129 birds collected in ripening sunflower fields contained at least one food item in their esophagus. No

TABLE 1.—Mean percent dry weights[a] (MDW) and relative frequencies of occurrence[b] (RFO) of esophageal contents from common grackles collected in noncrop habitats[c]

	Time period							
	May 1–June 30 Spring n = 58		July 1–Aug 14 Summer n = 56		Aug 15–Sept 16 Late summer n = 65		Sept 17–Oct 21 Fall n = 61	
Food	MDW %	RFO %	MDW %	RFO %	MDW %	RFO %	MDW %	RFO %
Sunflower	8	8	4	3	41	36	55	43
Small grains[d]	13	13	42	41	41	34	31	25
Corn	0	0	7	6	0	0	0	0
Weed seeds[e]	0	0	9	10	tr[f]	3	4	5
Insects	79	79	34	37	16	25	8	26
Other	0	0	4	3	2	2	2	1

[a] Mean percent dry weight = wt of food ÷ wt of all food categories determined for each bird, then averaged over all birds, times 100

[b] Relative frequency of occurrence = no. of birds containing a food item ÷ the total number of occurrences of all food items in all birds, times 100

[c] Shelterbelts, wetlands and flight-lines

[d] Wheat, barley and oats

[e] Primarily foxtail (*Setaria* spp.) and wild oats (*Avena* spp.)

[f] tr = <0.5%

significant interactions were detected between age and sex ($F = 1.15$, df = 5, 590, $P = 0.334$), season and sex ($F = 0.96$, df = 5, 590, $P = 0.439$) and season and age ($F = 1.07$, df = 5, 590, $P = 0.378$). Esophageal contents did not differ between age ($F = 1.78$, df = 5, 590, $P = 0.115$) or sex classes ($F = 1.24$, df = 5, 590, $P = 0.288$).

Common grackles collected in sunflower fields contained more sunflower (95% of dry weight) and less small grains (1%) during late summer than in fall (sunflower—91%, small grains—5%; $F = 3.10$, df = 5, 590, $P = 0.009$). Insects were minor components, making up about 2.5% of the diets.

DISCUSSION

As expected, crop phenology and habitat influenced the diets of common grackles. Therefore, birds collected in different habitat and seasons were analyzed separately. The amount of insects found in adult common grackles from 1 May to 30 June (nesting season) was twice that found in any other collection period. Insects were probably readily available during this time while seeds were relatively scarce (Twedt *et al.*, 1991). Additionally, some of the birds may have been carrying insects in their oral cavity and esophagus for their young.

After the nesting season, small grains and insects dominated common grackle diets until sunflower began to mature in mid-August. Common grackles continued to feed extensively on sunflower seeds until they migrated in late October, suggesting that stage of sunflower maturation has little effect on their ability to obtain and shell sunflower achenes. Linz *et al.* (1984) found that red-winged blackbirds, which are about 30% smaller and have smaller bills than common grackles, tended to eat fewer sunflower seeds and more weed seeds as the season progressed.

The common grackles' preference for sunflower seeds over small grains is obvious when availability of both food sources is considered on a county-wide basis. Sunflower and small grains were planted on about 10% and 67% of the agricultural land, respectively, yet nearly equal amounts of both foods were consumed by grackles from mid-August to mid-September, when both crops were readily available. Moreover, farmers harass blackbirds feeding in ripening sunflower throughout the growing season but seldom bother the birds feeding in small grain fields (Handegard, 1988; Huffman, 1992).

After mid-September, the birds ate waste small grains in fields that had not been plowed. Additionally, in October some waste sunflower was gleaned by the birds in harvested fields.

Clearly, both male and female common grackles damage sunflower in North Dakota. In comparison, male red-winged blackbirds and yellow-headed blackbirds use more sunflower and fewer weed seeds than do the females of these species (Linz *et al.*, 1983; Linz *et al.*, 1984; Twedt *et al.*, 1991). This is probably related to the males' larger size (35% to 40%) and larger bills (Orians, 1961; Twedt, 1990), which may enable the males to harvest and shell sunflower achenes more efficiently than the females (Linz *et al.*, 1984). Apparently, the large size (>95 g) of both male and female common grackles gives them equal access to sunflower achenes.

In North Dakota, stubble grain fields are typically plowed soon after harvest; thus, much of the waste grain is buried. Sunflower harvest does not start until early October and frequently is not completed until December. Moreover, stubble sunflower fields often are not plowed until spring, leaving a readily obtainable food source for migrating birds. The availability of an energy-rich food, such as sunflower, may increase the survival rate of common grackles by enhancing their physical condition during spring and fall migration. We speculate this abundant, relatively new food supply (late 1960s), in combination with increased planting of trees preferred by nesting common grackles (*e.g.*, blue spruce, *Picea pungens*; Homan, 1992), may be factors contributing to the steady increase of the common grackle's breeding population in the northern Great Plains.

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